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## IMPROVED INTERFACE FOR A TELECOMMUNICATION SYSTEM

### Background of the Invention

5 This invention is generally directed to an improved interface for use in connection with a telecommunication system. A telecommunication system often includes a telephone switching system and an adjunct processor such as a voice messaging system (VMS).

10 The telephone switching system processes messages from multiple telephones and their users. These messages are often further processed and stored in the VMS.

15 Messages in the telecommunication system are comprised of a voice component and a data message component. The voice component relates to the voice message which has been recorded and the data component identifies information, such as, where the call originated, the destination of the call, and the time of the call. The present invention relates only to the processing of the data component of the messages.

A problem which is often encountered in a telecommunication system is that the telephone switching system utilizes a different protocol than the adjunct processor. A protocol is a set of rules governing the format of data which is exchanged between microprocessors. Two types of protocols, for example, are Application Processor Interface (API) and Simplified Message Service Interface (SMSI). In order for data messages to be forwarded from the telephone switch to the adjunct processor, the microprocessor within the adjunct processor must recognize the protocol of the data messages from the telephone switch. Likewise, in order for data messages to be forwarded from the adjunct processor to the telephone switch, the microprocessor within the telephone switch must recognize the protocol of the data messages from the adjunct processor. Often however, telecommunication switches and adjunct processors do not utilize the same protocol. For example, many switches operate using API protocol and many VMS operate using SMSI protocol. In order for the VMS and the telecommunication switch to operate together an interface (or protocol converter) is needed to convert the API protocol messages delivered from the switch to SMSI protocol. Once the data is formatted in SMSI protocol, the data can be utilized by the VMS. Similarly, the data delivered from the VMS is converted from SMSI protocol to API protocol so that it may be utilized by the switch.

In the past, interfaces have been used to accomplish the translation of data messages between telephone switches and VMS. A number of problems, however, have been encountered when these interfaces are implemented. First, the number of messages which can be transmitted between the switch and the VMS is limited by the capacity

of the interface. Another problem is the failure of the transmission link provided by the interface. Because all messages to be processed by the VMS must be transmitted through the interface's single link, if the link fails, no messages can be delivered to the VMS. Moreover, when links fail it is often difficult to determine the cause of the failure.

Previously the problems of link failure have been solved by connecting an additional interface between the telephone switch and the VMS. The use of a second interface, however, doubles the cost of the system and the space required for housing the system. Additionally, although additional capacity is provided by the second interface, this additional capacity is often unnecessary. In many situations, the capacity provided by a single interface is sufficient to meet the demands of the system. The problem rather lies in failure of the link provided by the interface and the inability of the interface to process and translate data messages upon failure of the link.

The present invention provides an improved interface which overcomes the problems presented in the prior art and which provides additional advantages over the prior art, such advantages will become clear upon a reading of the attached specification in combination with a study of the drawings.

## Objects and Summary of the Invention

An object of the present invention is to provide an interface with improved performance;

5 Another object of the present invention is to provide an interface with improved reliability;

10 A further object of the present invention is to provide an interface which improves the performance and reliability of the system while minimizing the number of electrical connections between the interface and the adjunct processor; and

A further object of the present invention is to provide a cost efficient interface.

15 Briefly, and in accordance with the foregoing, the present invention discloses an improved interface between a telephone switching system and an adjunct processor. The interface provided by the present invention allows for improved performance and reliability. The improved performance and reliability are achieved by utilizing multiple transmission links for processing data messages  
20 between the telephone switching system and the adjunct processor and by implementing unique operating software to selectively and automatically control the data transmission and retransmission of the data along the links. If one transmission link fails, all messages are  
25 processed by the remaining link or links.

## Brief Description of the Drawings

The organization and manner of the structure and operation of the invention, together with further objects and advantages thereof, may best be understood by  
5 reference to the following description, taken in connection with the accompanying drawings, wherein like reference numerals identify like elements in which:

FIGURE 1 is a block diagram representing a portion of a telecommunications system in which the interface of the  
10 present invention is used;

FIGURE 2a is a front perspective view of an embodiment of the interface of the present invention;

FIGURE 2b is a rear perspective view of the interface of the present invention;

15 FIGURE 3 is a block diagram representing the processing of messages by the interface between a telephone switch and a VMS;

FIGURE 4a is an outline of the steps performed by the device driver algorithm of the interface of the present  
20 invention when processing messages in the forward direction;

FIGURE 4b is an outline of the steps performed by the protocol stack algorithm of the interface of the present  
25 invention when processing messages in the forward direction;

FIGURE 4c is an outline of the steps performed by the splitting task algorithm of the interface of the present invention;

5      FIGURE 4d is an outline of the steps performed by the application task algorithm of the interface of the present invention when processing messages in the forward direction;

10      FIGURE 4e is an outline of the steps performed by the application task algorithm of the interface of the present invention when processing messages in the reverse direction;

FIGURE 4f is an outline of the steps performed by the combining task algorithm of the interface of the present invention;

15      FIGURE 4g is an outline of the steps performed by the protocol stack algorithm of the interface of the present invention when processing data messages in the reverse direction; and

20      FIGURE 4h is an outline of the steps performed by the device driver algorithm of the interface of the present invention when processing data messages in the reverse direction.

## Detailed Description of the Preferred Embodiment

While the invention may be susceptible to embodiment in different forms, there is shown in the drawings, and herein will be described in detail, a specific embodiment  
5 with the understanding that the present disclosure is to be considered an exemplification of the principles of the invention, and is not intended to limit the invention to that as illustrated and described herein.

10 As shown in FIGURE 1, the interface 10 of the present invention is to be used in a telecommunication system. The telephone switching system 14 provides communication services for a number of telephones 12 and their users. One type of switch 14 typically used in a  
15 telecommunication system is the 5ESS switch made by Lucent Technologies, for example. The interface 10 provides a connection for the transmission of data messages from the telephone switching system 14 to the adjunct processor 18 and from the adjunct processor 18 to the telephone switching system 14. The adjunct processor  
20 18 shown in FIGURE 1 is a Voice Messaging System (VMS). Although the interface 10 of the present invention could be adapted for use with other types of adjunct processors, the interface 10 of the present invention will be shown and described in connection with a VMS.

25 The present invention will be described in the context of a VMS which utilizes SMSI protocol and a telephone switch which utilizes API protocol, although it is to be understood that the present invention can be used with a telephone switch and adjunct processor which utilize any  
30 protocol. Because the telephone switch 14 the VMS 18 do not utilize the same protocol, the interface 10 of the present invention provides the necessary translation.

Within the context of this description of the invention, when the interface 10 receives messages from the switch 14 and delivers the messages to the VMS 18 it is said to be operating in the forward direction. When the  
5 interface 10 receives messages from the VMS 18 and delivers the messages to the switch 14 it is said to be operating in the reverse direction. When operating in the forward direction, the interface 10 receives API protocol messages from the switch 14 and delivers the  
10 messages to the VMS 18 in SMSI protocol. When operating in the reverse direction, the interface 10 receives SMSI protocol messages from the VMS 18 and delivers the messages to the switch 14 in API protocol.

As shown in FIGURES 2a and 2b, the interface 10 has a  
15 generally rectangularly shaped housing 20 which houses the hardware and software components of the interface 10. Electrical connection of the interface 10 is provided through the rear panel 22 of the housing 20. Connectors 24a, 24b provide electrical connection between the  
20 interface 10 and the switch 14. Connector 26 provides electrical connection between the interface 10 and the VMS 18. Power is supplied to the interface 10 through a power cord 28. In the preferred embodiment, an additional connector 30 is provided for allowing  
25 electrical connection of a diagnostic device.

The front panel 32 of the interface housing 20 includes several light emitting diodes (LEDs). A power LED 34 indicates whether power has been provided to the interface 10. Port status LEDs 36 provide indication of  
30 which connectors 24a, 24b 30 are in use. Link status LEDs 38 provide indication that data is being transmitted over the particular link indicated.



FIGURE 3 is a diagram which represents the hardware connections between the switch 14, the interface 10 and the VMS 18. Unlike prior art interfaces, multiple electrical connections between the interface 10 and the switch 14 are provided by, for example, the connectors 24a, 24b which allow for the processing of data messages over multiple links. The connector 26 provides connection between the interface 10 and the VMS 18.

Although it is fully contemplated that the interface can provide more than two transmission links, for purposes of clarity in explanation, the invention will be described below as including only two transmission links. The processing of the data messages by the software component of the interface 10 is also shown in FIGURE 3. The diagram shows the forward flow of data messages from the switch 14 to the VMS 18 and the reverse flow of data messages from the VMS 18 to the switch 14. The software component of the interface 10 is a series of algorithms which resides in the microprocessor of the interface 10. This microprocessor is typically mounted to a circuit board which is mounted within the housing 20 of the interface 10. The microprocessor includes flash, dynamic and RAM memory. When power is delivered to the interface 10 the algorithmic software program is copied from the flash memory, to the dynamic memory and finally to the RAM where the program is executed. The interface's program is responsible for processing and translating messages between the switch 14 and the VMS 18. The software of the interface 10 is programmed such that the interface receives and processes data through two links provided by connector 24a, 24b. The software of the interface 10 is a series of algorithms/routines which process data messages between the switch 14 and the VMS 18. Each algorithm is a series of instructions which

perform specific functions associated with processing the data messages.

More specifically, in the forward direction, messages packets are transmitted to the interface 10 from the switch 14 via the connectors 24a, 24b. A message packet contains data related to one or more individual messages. The message packets are processed through the two links and transmitted to the VMS 18 through the connector 26. The connectors 24a, 24b of the interface 10 are connected to the switch 14 in a customary manner, such as that provided by Lucent Technologies specification 235-900-303 which details the protocol that is being utilized, and is incorporated herein by reference.

Processing of the data messages includes several steps. The forward processing of messages from the switch 14 to the VMS 18 will first be described. On the first link provided by the interface, the message packets are transmitted from the switch 14 to a first device driver algorithm 42 through the connector 24a. The driver for the port is to be implemented in the form of an interrupt service routine and can process both B and D channel data. An intelligent ISDN controller chip such as the PEB 2086, manufactured by Siemens Semiconductors can be used for implementation of the ISDN port.

The steps performed by the device driver algorithm 42 operating in the forward direction are shown in FIGURE 4a. The device driver algorithm 42 receives the data message packets, filters erroneous frames from the message packets, and forwards the message packets to the protocol stack algorithm 44.

The protocol stack algorithm 44 validates the message packets. The steps performed by the protocol stack algorithm 44 when processing data messages in the forward direction are shown in FIGURE 4b. The protocol stack  
5 algorithm 44 performs three layers of validation. The first layer of validation is comprised of basic error checking. A second layer of validation confirms that the proper protocol as directed by the connector 28a has been met. The third layer of validation confirms that the  
10 proper protocol as directed by the switch 14 has been met. In the case of the 5ESS switch, the third layer of validation is to confirm that the data meets the proper API protocol. After completion of the validation by the protocol stack algorithm 44, the message packets are  
15 forwarded to the splitting task algorithm 46.

The splitting task algorithm 46 splits the message packets into individual messages. The steps performed by the splitting task algorithm 46 are shown in FIGURE 4c. After splitting the message packets into individual  
20 messages, the messages are forwarded to the application task algorithm 38.

The application task algorithm 48 translates the individual messages from API protocol to SMSI protocol. The steps of the application task algorithm 48 when  
25 processing messages in the forward direction are shown in FIGURE 4d. After translation, the application task algorithm 48 transmits the translated messages to the VMS 18 by way of the connector 26.

On the second link provided by the interface 10, the data  
30 messages are processed in the forward direction in the following manner. The message packets are transmitted from the switch 14 to a first device driver algorithm 52

through the connector 24b. The steps of the device driver algorithm 52 are shown in FIGURE 4a. The device driver algorithm 52 receives the message packets, filters erroneous frames from the message packets, and forwards  
5 the message packets to the protocol stack algorithm 54. The protocol stack algorithm 54 validates the message packets. The steps performed by the protocol stack algorithm 54 is shown in FIGURE 4b. The protocol stack algorithm 54 performs three layers of validation in the  
10 same manner as the protocol stack algorithm 44. After completion of the validation by the protocol stack algorithm 54, the message packets are forwarded to the splitting task algorithm 46.

The splitting task algorithm 46 splits the message  
15 packets into individual messages. The steps of the splitting task algorithm are shown in FIGURE 4c. After splitting the message packets into individual messages, the messages are transmitted to the application task algorithm 48.

20 The application task algorithm 48 translates the individual messages from API protocol to SMSI protocol. The steps of the application task algorithm are shown in FIGURE 6. After translation, the application task algorithm 38 transmits the translated messages to the VMS  
25 18 by way of the connector 30.

In the reverse direction the interface 10 transmits individual data messages from the VMS 18 to the interface 10. The data messages are processed in the following manner.

30 Individual messages are transmitted from the VMS 18 to the application task algorithm 38 through the connector

30. The application task algorithm translates the individual SMSI protocol messages into individual API protocol messages and forwards the messages to the combining task algorithm 56. The steps performed by the application task algorithm when processing messages in the reverse direction are shown in FIGURE 4e.

The combining task algorithm 56 combines individual API protocol messages into API protocol message packets and forwards the message packets to the protocol stack algorithms 34, 44. The combining task algorithm 46 alternates delivery of message packets between the two protocol stack algorithms 44, 54. The steps performed by the combining task algorithm 56 are shown in FIGURE 4f.

The protocol stack algorithm 44 receives the message packets from the combining task algorithm 56 and validates the message packet. The protocol stack algorithm 54 receives the message packets from the combining task algorithm 56 and validates the message packets. The steps performed by the protocol stack algorithms 44, 54 in the reverse direction is shown in FIGURE 4g.

Additional visual representations of the context and queue of each of the key tasks performed by the interface of the present invention are shown in Appendix A.

After validation, the protocol stack algorithm 44 transmits the message packets to the device driver algorithm 42 and the protocol stack algorithm 54 transmits the message packets to the device driver algorithm 52. The device driver algorithm 42 transmits the message packets to the switch 14 through the connector 24a and the device driver algorithm 52

transmits the message packets to the switch 14 through the connector 24b. The steps performed by the device driver algorithms 42, 52 when processing messages in the reverse direction are shown in FIGURE 4h.

5 Thus, in the two-link interface described a first link is formed by the connector 28a, the device driver algorithm 42, protocol stack algorithm 44, the splitting task algorithm 46, the application task algorithm 48, and the connector 26. A second link is formed by the connector  
10 24b, the device driver algorithm 52, the protocol stack algorithm 54, the splitting task 46, the application task 48 and the connector 48. With the addition of the second link, the interface 10 provides improved performance in that the transmission of the data is divided between each  
15 of the two links. The addition of a second link also improves the interface reliability. In the event that the first link fails, all data messages are processed by the interface through the second link. Likewise, if the second link fails, all messages are processed by the  
20 interface through the first link. Unlike the prior art, the interface of the present invention can continue to operate in the event of link failure. By providing multiple links within the interface 10, for processing data between the switch 14 and the VMS 18, the  
25 reliability of the interface is improved without unnecessarily increasing the cost and capacity of the interface.

The improved performance of the interface of the present invention is achieved without increasing the rack space  
30 occupied by the interface. The additional connector needed to provide a two link interface can be added to rear panel 22 of the panel housing 20 without increasing the size of the panel. The additional software needed to

provide a two link interface can be accommodated on the existing circuit board within the housing 20.

If two prior art interfaces were used in an attempt to improve reliability and performance, three additional electrical connections would be needed. An additional connection would be needed between the switch 14 and the second interface, between the second interface and the VMS, and to power the second interface. The use of a two link interface however, requires only one additional electrical connection between the switch 14 and the interface 10.

As noted above, although the interface of the present invention has been shown and described as having two links, the interface 10 could be constructed with more than two links. For example, three connectors could be provided between the switch 14 and the interface 10, thus providing three links. In a three link interface, three device drivers and three protocol stacks would also be provided. The splitting task algorithm would receive data messages from three protocol stacks and would deliver these messages to the application task algorithm 48 for translation. When operating in the reverse direction, the combining task of a three link interface would deliver the message packets to three protocol stacks in an alternating fashion. In the event of a link failure in a three link interface, the remaining two links would continue to process the data messages. Additionally, if two of the three links failed, the remaining link would be available to process and translate the data messages.

While preferred embodiments of the present invention are shown and described, it is envisioned that those skilled

in the art may devise various modifications of the present invention without departing from the spirit and scope of the appended claims.

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